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(54) **Disposable filter**

(57) A disposable filter suitable for excluding blood or blood foam from a manometer connection in a dialysis system comprises a housing in which a hydrophobic flat filter element (4) of square outline separates a lower chamber (12) from an upper chamber (11) with a filter support 3, the element (4) being sealed at its periphery between the rims of two interconnected members (1, 5) of the housing. The two chambers have centrally arranged connecting stub pipes (2, 6). The lower chamber (12) may enclose a second filter support, is larger than chamber (11) and merges smoothly from a generally square cross-section at the top to a lower hemispherical section.

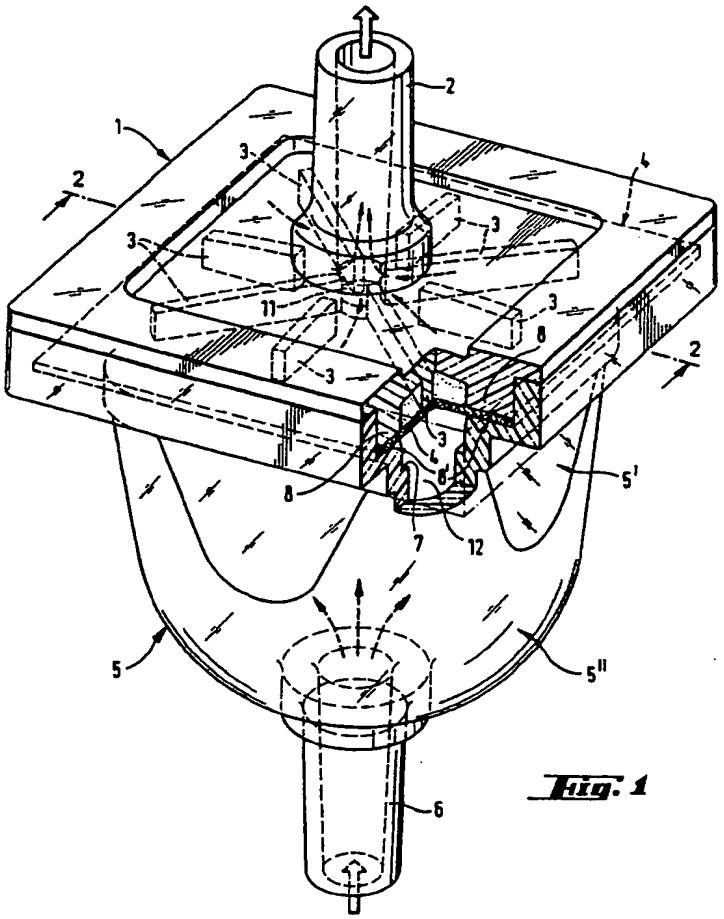


Fig. 1

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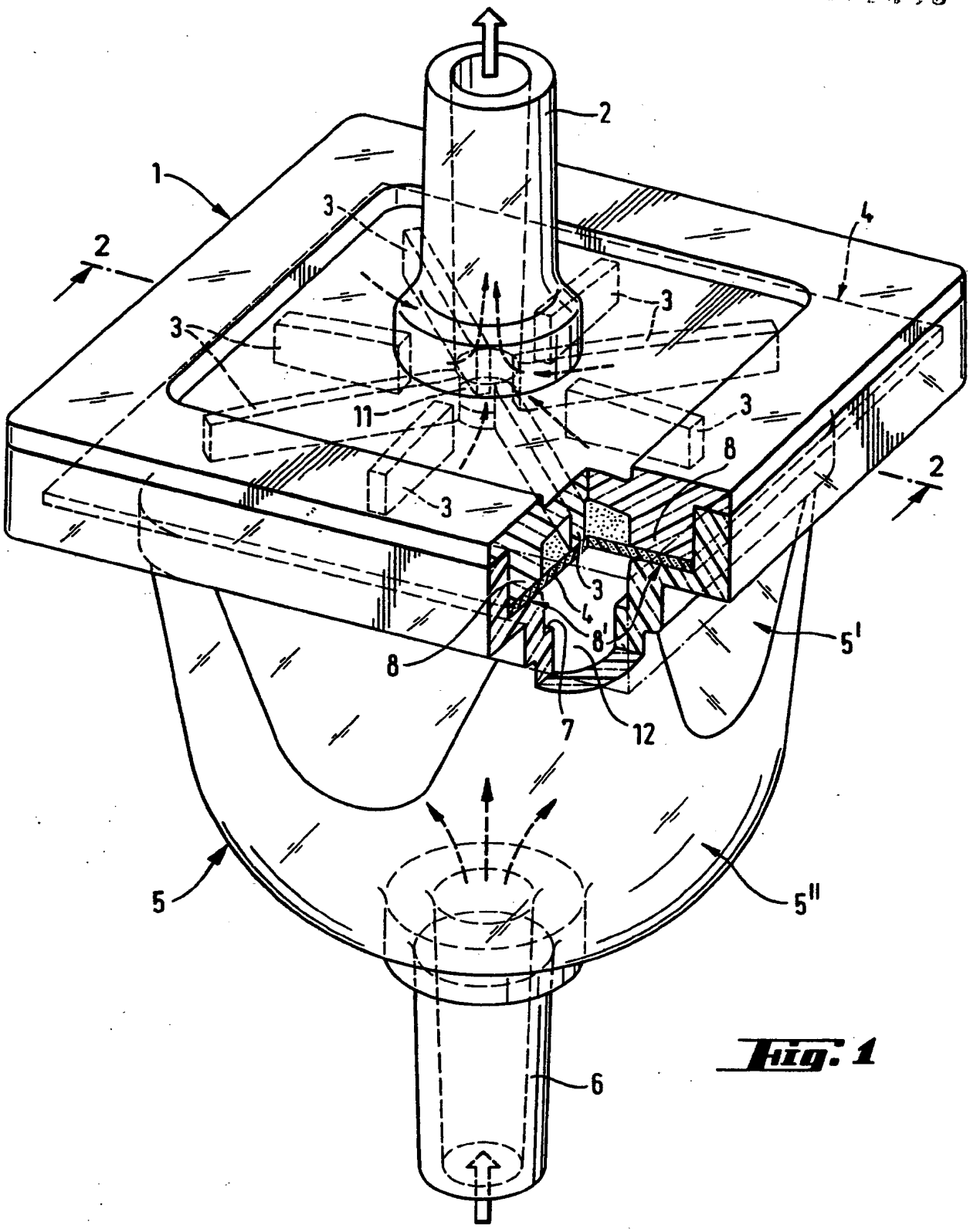
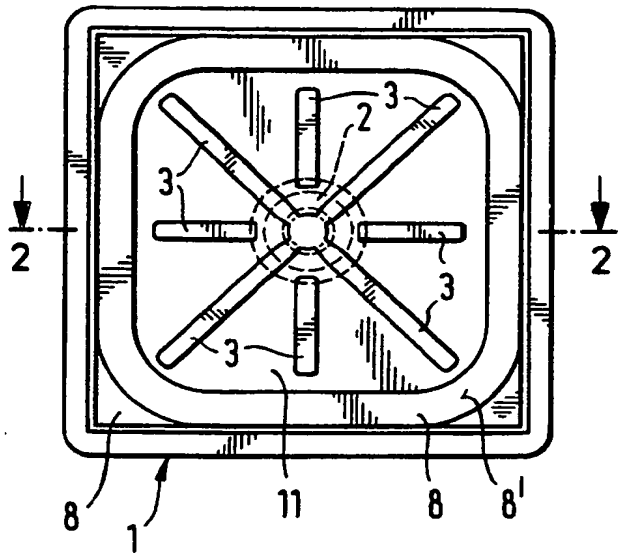



Fig. 1

Fig. 3



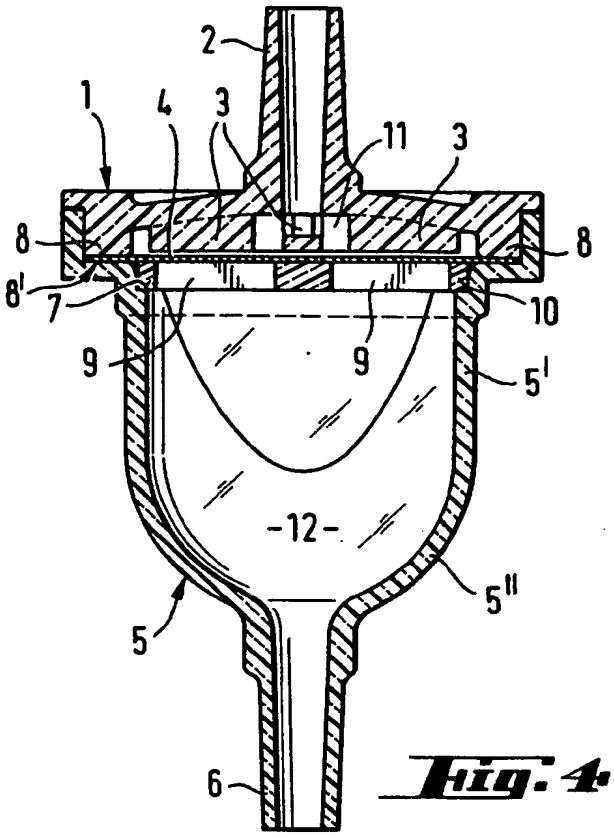
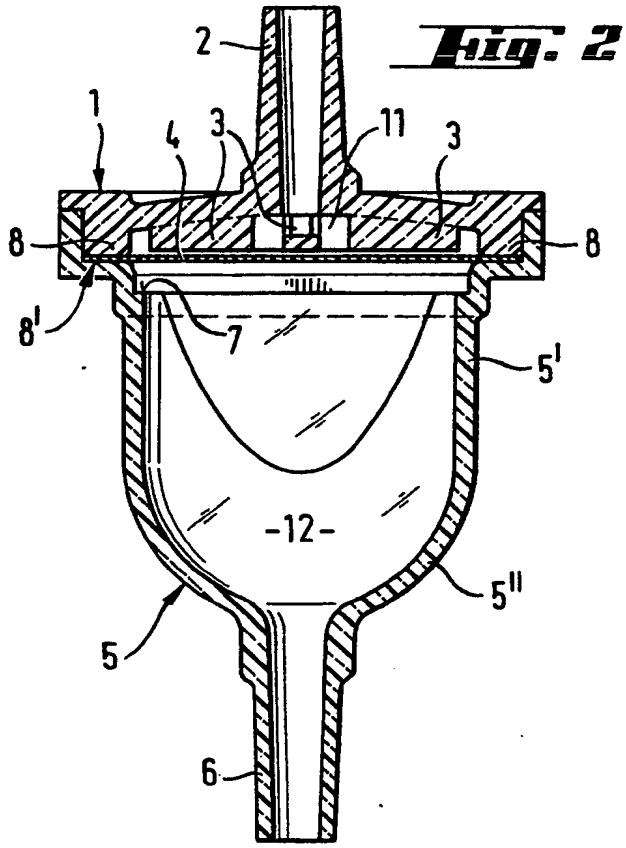




Fig. 4

Fig. 2



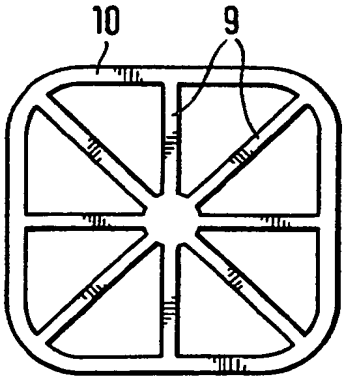




Fig. 5

SPECIFICATION
**Disposable filter**

The present invention relates to a disposable filter, especially a filter suitable as a blood surface barrier.

For the sterile aeration of containers and hose systems, disposable filters of small volume are customarily used, as known from DE—OS 32 02 330. In haemodialysis machines and haemofiltration machines for use as artificial kidneys, a so-called blood surface barrier in the form of a filter is used for reasons of safety in front of a pressure manometer for the measurement of the blood pressure prevailing in the extracorporeal system. A hydrophobic filter membrane prevents blood or blood foam from penetrating into the interior of the manometer and polluting it and indeed prevents blood from issusing from the hose system at all. The operator has to recognise rising of blood or blood foam and provide a remedy. To carry this out, the connection of the blood filter to the manometer is detached and the blood surface is urged away from the underside of the membrane with the aide of a syringe. It has to be ensured, for reasons of safety, that no blood penetrates through the membrane and exposes the operator to the danger of hepatitis. The blood surface barriers at present available have a round filter cross-section, i.e. also the housing parts are rotationally symmetrical. A larger funnel-shaped chamber disposed in front of the hydrophobic membrane additionally ensures that blood foam is able to dissolve as soon as it arises. In the known filters, the housing spaces for the blood are so small that foam removal hardly occurs. Too large a housing space is undesired on the other hand, since as little blood as possible should dwell in the duct system and the duct system should also contain as little residual blood as possible at the end of the treatment.

The known, rotationally symmetrically constructed filter housings are not particularly convenient to manipulate in respect of the frequent detaching from the hose system. A further disadvantage is that, to provide a certain active filter area, the waste in the case of round flat filter blanks is relatively high and the cutting operation increases manufacturing costs. A disposable filter is thus desired which is as small and cheap as possible and yet at the same time has as large as possible effective filter area and is convenient for manipulation.

According to the present invention there is provided a disposable filter comprising a first housing member defining a first fluid collecting chamber which communicates with a first fluid port, a second housing member secured to the first housing member and defining a second fluid collecting chamber which is larger in volume than the first chamber and which communicates with a second fluid port, and a selectively permeable hydrophobic flat filter element of substantially square outline shape which is fluid-tightly clamped at its perimetral region between substantially correspondingly shaped clamping surface portions of the two housing members thereby to separate the first and second chambers from each other and which is supportable at one face thereof by support means in the first chamber, the second chamber being bounded in a region adjoining the filter element by a substantially parallelepipedonal first wall portion and in the remaining region by a substantially hemispherical second wall portion which merges into and has a maximum diameter substantially equal to the side length of the first wall portion and which is provided at its crown with the second fluid port.

In a preferred embodiment, the filter is suitable as a blood surface barrier for the sterile gas exchange in closed containers and hose systems, wherein the selectively permeable hydrophobic flat filter element separates a lower larger collecting space for the fluid (liquid or gas) to be degassed from an upper smaller collecting space for the gas exchange and equipped with a draining filter support, the element being enclosed in leak-proof manner at the rim between two housing members of plastics material which are durably connected with each other. Both collecting spaces pass over into round, centrally arranged connecting stub pipes of the housing members. The filter element has a square outline shape and a clamping bearing, which is formed at the rim by both housing parts, for the filter element is constructed correspondingly. The free filter area facing the lower housing space is bounded by a substantially parallelepipedonal housing wall of the lower housing member, which wall passes over smoothly into a hemispherical housing wall and ends in the lower connecting stub pipe. The diameter of the hemisphere about corresponds to the diameter of the inscribed circle of the parallelepipedonal portion and the transitions in the inner housing cross-section are rounded. For preference, the lower housing member has an encircling step directly in the plane of the clamping bearing, which step limits the size of the free filter area and is constructed as a receiving recess for a support grid, edged in the manner of a frame, of plastics material for the underside of the flat element. The element is preferably a microporous membrane of polytetrafluoroethylene. Such a filter may have improved manipulation, have an optimally dimensioned housing volume available for blood foam to facilitate foam removal, and improved filter performance by simple means without increasing the filter element and cutting area necessary for the attainment of a sufficient filter performance.

Embodiments of the present invention will now be more particularly described by way of example with reference to the accompanying drawings, in which:

Fig. 1 is a partly sectional perspective view of a disposable filter embodying the invention;

Fig. 2 is a vertical section of the filter of Fig. 1 along the line 2—2 in Figs. 1 and 3;

Fig. 3 is an inverted plan view of an upper housing member of the filter;

Fig. 4 is a vertical section of the filter of Fig. 1 but with inserted lower filter support; and

Fig. 5 is a view of the inserted lower filter support.

Referring now to the drawings, there is shown a filter with a filter housing built up from two parts, i.e. an upper housing part 1 and a lower housing part 5, which have central connecting stub pipes 2 and 6 respectively. The housing part 1 has an integral filter support formed by mutually crossing ribs. The mutually facing rims of the housing parts are constructed for the reception of a square flat filter element 4, for example of an edge length of 22 millimetres, wherein the receiving bearing 8 of both housing parts has a clamping zone 8' in which the clamping outlines are rounded in the corners to avoid stressing the sensitive filter element 4 at its corners. Notwithstanding these rounded corners, the utilisation of the free filter area is substantially more favourable than for a circular filter blank. The filter element 4 can be cut substantially more favourably from the band than circular blanks which as a rule result from the punching operation of a circular cutting tool. Rectangular blanks are more economical particularly in the case of relatively expensive filter materials, such as polytetrafluoroethylene.

The lower housing part 5 passes over from its square outline shape at the inside initially into a step 7, which is constructed as receiving recess for a separate and selectably insertable frame 10 with filter element support ribs 9, as illustrated by itself in Fig. 5 and inserted in the lower housing part 5 in Fig. 4.

The parallelepipedonal portion 5' of the lower housing part 5 passes smoothly over into a hemispherical portion 5'', which in turn ends in the central round stub pipe 6. As is evident from Fig. 1, the transitions arising thereby are formed by four parallel surfaces so that a chalice-shaped collecting space 12 results in the lower part. The collecting space 11 in the upper housing part 1 is of substantially smaller volume. This larger collecting space 12 gives foaming liquid, for example blood foam, the possibility of dissolving before reaching the filter element 4. The element 4 prevents passage of blood or blood foam in the direction of the connecting stub pipe 2, behind which a pressure manometer can be arranged.

Both housing parts are formed of transparent synthetic, for example plastics, material and connected at their rims by, for example, ultrasonic welding. The filter supports 3 and 9, provided at both sides in the embodiment according to Fig. 4, permit a pressure loading of the filter element in both directions. This can be desirable for certain fields of use.

The rectangular construction of the interconnected housing flanges enhances handiness and facilitates manipulation of the filter housing when it is to be detached at either or both sides from the hose connections. The stub pipes 2 and 6 can also be equipped with screw connections usual in medical articles.

CLAIMS

1. A disposable filter comprising a first housing member defining a first fluid collecting chamber which communicates with a first fluid port, a second housing member secured to the first housing member and defining a second fluid collecting chamber which is larger in volume than the first chamber and which communicates with a second fluid port, and a selectively permeable hydrophobic flat filter element of substantially square outline shape which is fluid-tightly clamped at its perimetral region between substantially correspondingly shaped clamping surface portions of the two housing members thereby to separate the first and second chambers from each other and which is supportable at one face thereof by support means in the first chamber, the second chamber being bounded in a region adjoining the filter element by a substantially parallelepipedonal first wall portion and in the remaining region by a substantially hemispherical second wall portion which merges into and has a maximum diameter substantially equal to the side length of the first wall portion and which is provided at its crown with the second fluid port.

2. A filter as claimed in claim 1, wherein each of the housing members is made of plastics material.

3. A filter as claimed in either claim 1 or claim 2, wherein the fluid ports are each arranged concentrically with a central axis of the filter.

4. A filter as claimed in any one of the preceding claims, comprising a support grid arranged in an internal recess of the second housing member to support the filter element at the other face thereof.

5. A filter as claimed in claim 4, wherein the support grid is made of plastics material.

6. A filter as claimed in any one of the preceding claims, wherein the filter element is a microporous membrane of polytetrafluoroethylene.

7. A filter as claimed in any one of the preceding claims, the filter element being impermeable by blood but permeably by gas entrained by the blood.

8. A filter substantially as hereinbefore described with reference to Figs. 1 to 3 of the accompanying drawings.

9. A filter substantially as hereinbefore described with reference to Figs. 4 and 5 of the accompanying drawings.

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